ANALYSIS

53(258), June 1, 2017

ISSN 2278–5469 EISSN 2278–5450

Discovery

Bacteriological analysis of chicken parts of fresh and frozen poultry chicken sold in Gombe metropolis, Nigeria

Suleiman MA[1]☼, Wasa AA[1], Na'ilatu MI[1], Inusa Titus[2], Salawudeen Adamu[1]

1.Department of Microbiology, Faculty of Science, Gombe State University, Gombe, Nigeria
2.Department of Biological Sciences, School of Science, Abubakar Tafawa Balewa University (ATBU) Bauchi, Nigeria

☼**Correspondent e-mail:** suleimanmuhammedabubakar@gmail.com

Publication History
Received: 22 March 2017
Accepted: 14 May 2017
Published: 1 June 2017

Citation
Suleiman MA, Wasa AA, Na'ilatu MI, Inusa Titus, Salawudeen Adamu. Bacteriological analysis of chicken parts of fresh and frozen poultry chicken sold in Gombe metropolis, Nigeria. *Discovery*, 2017, 53(258), 345-352

General Note
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ABSTRACT

This study was aimed to comparatively analyze bacteria associated with fresh and frozen poultry chicken parts (gizzard, head and leg) sold in Gombe metropolis, Nigeria. A total number of thirty- six (36) samples were collected randomly from six (6) different retail outlets within Gombe metropolis. During this study a total number of five (5) bacteria genera were isolated and identified. The identified bacteria genera were E. col (21%; 26.9%), Staphylococcus aureus (24%; 30.9%), Salmonella spp (30%; 19.5%), Listeria monocytogens (8.9%; 8.0%), and Staphylococcus epidermidis (15%; 14.6%) for both fresh and frozen poultry chicken respectively. The mean value of the total aerobic bacteria count of the chicken parts analysed showed $5.30x10^5$; $4.60x10^4$ for gizzard, $3.20x10^5$; $3.71x10^4$ for head and $3.10x10^5$; $4.55x10^4$ for leg of both frozen and fresh poultry chicken' parts. It was shown that the gizzard contained more bacteria than both the head and the leg for both the frozen and fresh chicken parts analysed. More also the frozen chicken parts were more heavily contaminated than the fresh chicken parts. In conclusion, the contamination of the poultry chicken might be due to poor unhygienic habit observed during slaughtering, processing and storage.

Keywords: Bacteria, Fresh and frozen chicken parts, Gombe

1. INTRODUCTION

Chicken is one of the most widely used meats in the world largely because its protein is of excellent quality and contains all the essential amino acids needed by man. However, chicken is not only highly susceptible to spoilage, but also frequently implicated in tread soft food borne illness. During the various stages of slaughter and processing, all potential edible tissues are subjected to contamination from a variety of sources within and outside the animal (Kozacinski*et al*., 2008) and also from the environment, equipment and operator. Over 30 genera of microorganism are known to contaminate poultry product (Derman and Rose, 2007).

Generally, the microbial quality of meat products including chicken has purchased by consumers depends on factor such as the quality of raw products and other materials used or added during processing operations to the product has extraneous contaminants; efficacy of cooking process; sanitation during processing and packaging; maintenance of adequate refrigeration from the processing to the retail level and to the consumer; and finally sanitation during handling at the retail end (Selvan*et al.*, 2007).

Poultry meat offers an excellent medium for the multiplication of most bacteria, including those that are not inhibited by low temperatures, storage of processed poultry meat is vita and therefore considered only under circumstance which inhibit the multiplication of the initial load of bacteria.

Several efforts put in place to reduce the microbial load of chicken meat had only limited success (Vilar*et al*., 2000). According to theWaring*et al*., (2011), the elimination of pathogenic microorganism in poultry depends largely on the correct application of processing technologies such as pasteurization, irradiation, cooking, freezing and pickling at the industrial, retail and domestic levels. Despite these efforts invested in eliminating pathogenic microorganisms in poultry and methods of improving hygienic procedures in the processing of poultry over the year, the product continues to be heavily contaminated with various microorganisms.

Epidemiological reports suggest that poultry meat is still the primary cause of human food poisoning (Mulder, 1999). According to Fries (2002), the micro flora of poultry is transferred from the primary production sites to contamination. Micro flora of crude chicken meat is heterogeneous and originates from slaughtering premises, operators hands, equipment and outfit, water and air.

Therefore, an efficacious way of preventing poultry borne human diseases is to monitor the microbiological quality of poultry meat and meat products during production, transportation, storage and distribution.

2. MATERIAL AND METHODS

A total number of thirty six (36) freshand frozen poultry meat samples were aseptically collected randomly from six (6) retail outlets namely: Al-qassimsuya spot, Kasuwan Mata, Main market, TashanDukku, Pantami market, and Jamji market, within Gombe metropolis. The collected samples comprised of twelve (12) each of gizzards, legs and heads, wrapped in aluminum foil and transported in sealed containers to the Microbiology laboratory of Gombe State University for further analysis.

Media Preparation

All the media used in the study were prepared according to the manufacturer's instructions. The media used include Nutrient agar, MacConkey agar, plate count agar and Mannitol salt agar.

Sample Preparation

Preparation of Homogenate of Chicken Sample

The method described by Moshood*et al*., (2012) was adopted. The meat from the various chicken parts was aseptically separated from the bone with the aid of sterile knives. Ten (10) grams of each of the various chicken parts meat was separately grounded in a sterile mechanical blender. The chicken meat was blended at medium speed and slurry was obtained. One (1) gram of each of the slurry was weighed and mixed with ten (10) ml of peptone water. This was allowed to soak for 10 minutes and mixed thoroughly to homogenize thus served as the stock or the homogenate.

Serial Dilution

The prepared stock solutions were serially diluted in sterile test tubes up to 10^{-10} dilution. 1ml of the stock homogenate was consecutively added to 9 ml of sterilized distilled water. This was carried out to obtain distinct colonies from the sample Moshood *et al*., (2012).

Plating on Culture Media

The method describe by Chessbrough (2006) was adopted. One (1) ml of aliquot from 10^{-10} diluent was introduced to a molten media (agar) in an empty petri dish. The inoculated plates were incubated at 37^0c for 24 hours. Plating was done on a nutrient (agar) to estimate the total isolates from the samples. This was done in triplicates, after the incubation the respective growths were counted using colony counter and recorded.

Identification of Isolated Bacteria

The characterization and identification of the colony isolates were achieved by initial morphological examination of the colonies in plates (macroscopically) for colony appearance, size, elevation, form, edge, colour, odour, opacity and pigment bacteria were identified macroscopically. Discrete colonies from triplicate plates were picked at random with a sterile wire loop and streaked on fresh plate of nutrient, MacConkey and Mannitol salt agar and incubated at 37°C for 24 hours. The stock cultures were obtained, labeled carefully. Gram staining was carried out to determine the cellular morphology of the isolated bacteria, sizes, shapes and its arrangement of the isolated bacteria. Biochemical tests such as catalase test, coagulase tests, oxidase test, indole production and urease utilization were also conducted on the isolated bacteria for proper identification Chessbrough (2006).

3. RESULTS

A total five different Bacteria species namely: *E.coli*, *Staphylococcusaureus*, *Salmonella*sp,*L. monocytogens, S. epidermidis,* were isolated and identified from the samples collected table 3 and 4.

The total aerobic mesophilic bacteria plate Count for the organisms isolated from fresh chickens was shown in table 1. Highest number of organisms was observed in Gizzard, followed by the head and the leg. Samples from Pantami Market were the most contaminated ($5.2x10^5$,$4.3x10^5$ and $4.0x10^5$) followed by Kasuwan Mata ($4.0x10^5$,$4.2x10^5$,$3.8x10^5$), while the least contaminant were found at Jamji market ($4x10^5$,$2.6x10^5$ and $3.0x10^5$) table 1

The total aerobic mesophilic bacterial plate count of organism isolated from the frozen chicken is shown in table 2. Highest number of organisms was also observed in Gizzard, followed by the Head and the Legs. Samples from Al-qassimsuya spot were the most contaminated ($6.2x10^4$,$7.0x10^4$ and $8.2x10^4$) followed by Kasuwan Mata ($7.6x10^4$,$6.4x10^4$ and $6.0x10^4$) while the least contaminant were found at TashanDukku ($1.5x10^4$,$1.0x10^4$ and $2.0x10^4$) table 2.

The percentage frequency of occurrence of the isolated bacteria was also presented in fig.1 and 2 below and it ranged with *E. col* (21%; 26.9%), *Staphylococcus aureus* (24%; 30.9%), *Salmonella sp*(30%; 19.5%), *Listeria monocytogens* (8.9%; 8.0%), *and Staphylococcus epidermidis* (15%; 14.6%)for both fresh and frozen poultry chicken respectively. The highest value was observed in Salmonella for fresh chicken and *S. aureus* for frozen chicken.

Table 1

Total Aerobic Mesophilic plate Count (cfu/ml) of bacteria isolated from frozen Chicken parts

Samples	Gizzard	Head	Leg
A1	$6.8x10^5$	$1.0x10^5$	$2.6x10^5$
B1	$5.2x10^5$	$4.3x10^5$	$4.0x10^5$
C1	$4.6x10^5$	$4.2x10^5$	$2.4x10^5$
D1	$4.2x10^5$	$4.0x10^5$	$3.8x10^5$

E1	$4.4x10^5$	$3.6x10^5$	$3.4x10^5$
F1	$3.0x10^5$	$2.6x10^5$	$2.4x10^5$
Mean	$5.30x10^5$	$3.20x10^5$	$3.10x10^5$

Keys: A1 – F1 = the outlets where samples were obtained

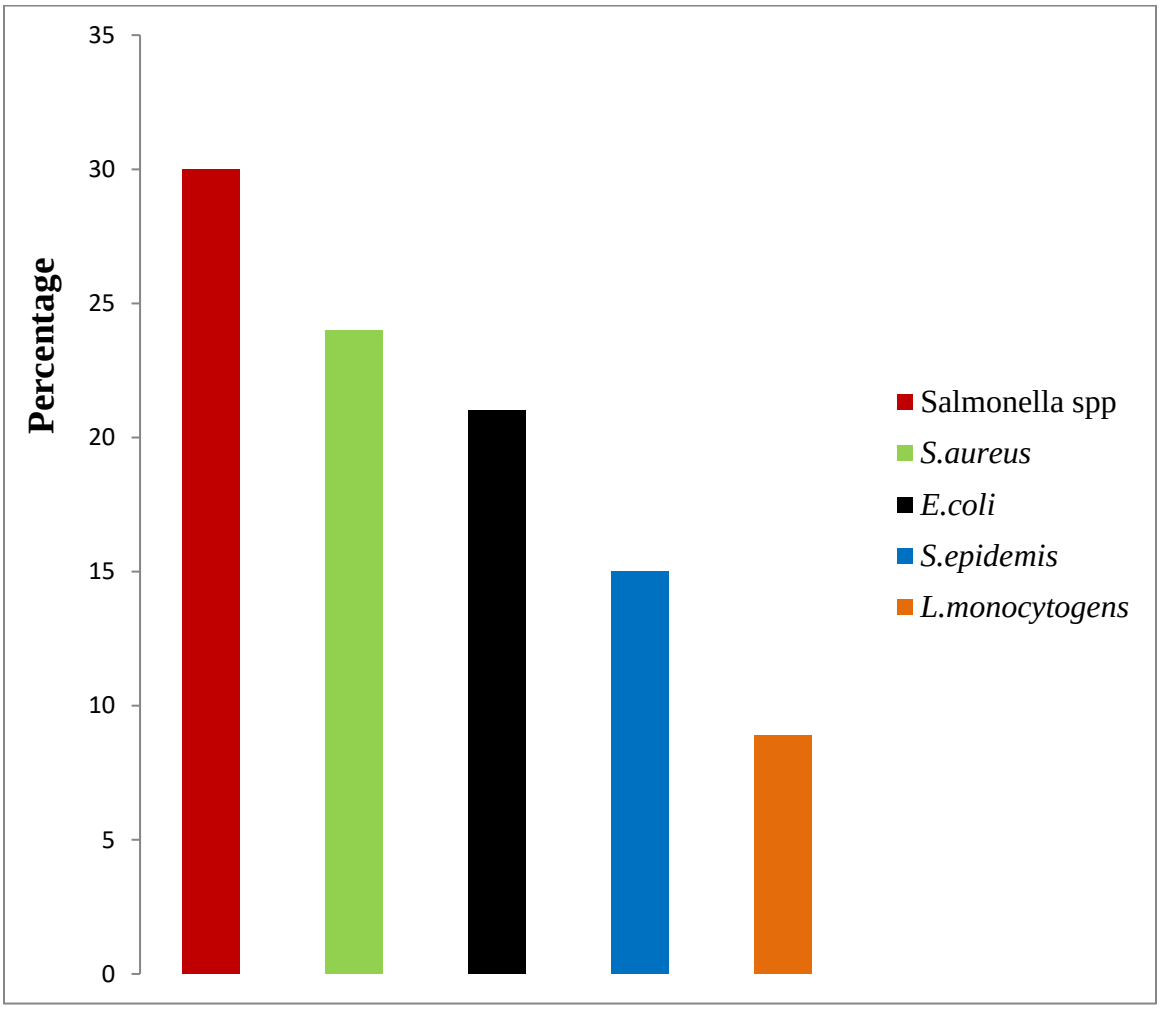

Figure 1
Percentage of occurrence of bacteria isolated from fresh chicken samples

Table 2
Total Aerobic mesophilic plate count (cfu/ml) of bacteria isolated from fresh Chicken parts

Sample	Gizzard	Head	Leg
A2	$1.5x10^4$	$1.0x10^4$	$2.0x10^4$
B2	$9.2x10^4$	$1.5x10^4$	$7.4x10^4$

C2	$2.3x10^4$	$1.9x10^4$	$1.1x10^4$
D2	$7.6x10^4$	$6.2x10^4$	$6.0x10^4$
E2	$7.6x10^4$	$6.4x10^4$	$6.0x10^4$
F2	$7.4x10^4$	$6.2x10^4$	$4.8x10^4$
Mean	$4.60x10^4$	$3.71x10^4$	$4.55x10^4$

Keys: A1 – F1 = the outlets where samples were obtained

Figure 2
Percentage of occurrence of bacteria isolated from frozen chicken samples

Table 3
Morphological and Biochemical Properties of Bacteria Isolated from fresh chicken Samples

Part	Colony	Colony Morph.	Gram Staining	Ca	Co	Ox	Ind	Ure	Mot	Probable Organism
Gizzard										*Salmonella sp.*
	A	Rod	-	+	-	-	-	-	+	
	B	Cocci	-	+	+	-	+	-	+	*E. coli*
Legs	A	Cocci	-	+	+	-	+	-	+	*E. coli*

	B	Rod	+	+	Nil	-	-	-	-	*L.monocytogens*
	C	Cocci	+	+	+	-	+	-	-	*S. aureus*
Heads		Cocci								
	A		-	+	+	-	+	-	+	*E. coli*
	B	Rod	-	+	-	-	-	-	+	*Salmonella sp.*

Keys: Ca=catalase, Co=coagulase, Ox=oxidase, Ind=indole, Ure=urease, Mot=motility, +=Positive, -=Negative.

Table 4

Morphological and Biochemical Properties of Bacteria Isolated in frozen chicken samples

Part	Colony	Colony Morph.	Gram Staining	Ca	Co	Ox	Ind	Ure	Mot	Probable Organism
Gizzard	A	Rod	+	+	Nil	-	-	-	-	*L.monocytogens*
	B	Cocci	+	+	-	-	-	-	-	*S. epidermidis*
	C	Rod	-	+	-	-	-	-	+	*Salmonella sp.*
Legs	A	Cocci	+	+	+	-	+	-	-	*S. aureus*
	B	Rod	+	+	-	-	-	-	+	*Salmonella sp.*
	C	Rod	+	+	Nil	-	-	-	-	*L. monocytogens*
Head	A	Rod	+	+	Nil	-	-	-	-	*L. monocytogens*
	B	Cocci	+	+	-	-	-	-	-	*S. epidermidis*
	C		+	+	+	-	+	-	-	*S. aureus*
	D	Cocci	-	+	+	-	+	-	+	*E. coli*

Keys: Ca=catalase, Co=coagulase, Ox=oxidase, Ind=indole, Ure=urease, Mot=motility, +=Positive, -=Negative.

4. DISCUSSION

It is obvious from the study that the frozen chicken is highly contaminated than the fresh chicken as it was shown in table 1 and 2 above. The mean viable bacteria count of the isolated bacteria ranged $5.30x10^5$ for gizzard, $3.20x10^5$ for head, $3.10x10^5$for leg and

4.60x104 for gizzard, $3.71x10^4$for head, $4.55x10^4$ for head of both frozen and fresh chicken respectively. This high bacterial load observed in frozen chicken could be attributed to contamination from the environment and personnel or from the materials used including water during processing, transportation and storage. Also from this result (table1 and 2) a high mean value was observed for gizzard $5.30x10^5$and $4.60x10^4$ for both frozen and fresh chicken, this is an indication that the gizzard serves has the digestive tract for chicken which and it harbours large amount bacterial normal flora which participated in the digesting process of food substances by the chicken. The result obtained was compared with the research carried out by Farka, (2010), both were in agreement that the gizzard contained the highest load of bacteria.

Five bacteria genera were isolated and identified during this study (table 3 and 4) namely: *E.coli*, *Staphylococcusaureus*, *Salmonella*sp,*L. monocytogens,* and *S. epidermidis*. The organisms isolated and identified were identified to be human normal body flora and environment associated bacteria. This suggests that those humans are the environment (soil, air, water) are the major source of bacterial contamination of chicken. The results were in accordance with the work of Sackey, (2010) who also isolated and identified almost similar bacteria genera.

The percentage occurrence of respective isolated bacteria was also presented in fig.1 and 2 for both fresh and frozen chicken respectively. The percentage occurrence ranged from *Salmonella*30%, *S. aureus*24%, *E. coli*21%, *S. epidermidis* 15%, to *L. monocytogens*8.9% for fresh chicken, and *S. aureus* 30.9, *E. coli* 26.9%, *Salmonella* 19.5%, *S. epidermidis* 14.6% to *L. monocytogenes* 4.0% for frozen chicken.

The high occurrence of*Salmonella*(19.5%) (fig.2) frozen poultry meat might be as a result of the bacterial load from fresh sample which was relatively high (30%) (fig.1) compared that from frozen meat sample.

The high occurrence of *Staphylococcusaureus* (30.1%) (fig.2) as observed in frozen chicken could be due to poor personal hygiene of workers and the technique used in eviscerating the chicken carcasses during processing.

The relatively high percentage of occurrence observed in *E. coli* 21% and 26.9% (fig.1 and 2) for fresh and frozen chicken respectively is an indication that the chicken is fecal contaminated directly or indirectly through the water used from environment or the personnel during processing. The result obtained was also compared with the work of Sackey, (2010) which showed a slight variation on the percentage of occurrence of relative bacteria isolated.

5. CONCLUSION

From the results of the study, it can be concluded chicken can be a very good medium for bacteria growth. The relative high bacterial load of poultry meat from fresh sample could be reflection of the poor handling of the meat, contamination from the environment during slaughtering, washing dressing of the meat, transportation and storage, unhygienic habit of the personnel observed during processing process. The contaminated chicken could be a vehicle for transmission of pathogens among the people which could be of a great public health risk to the consumers.

RECOMMENDATIONS

This study has revealed the existence of bacteria hazards related to the retailing of fresh and frozen chicken. It is therefore necessary to explore the use of an innovative food processing technology such as irradiation in addition to traditional temperature management techniques such as chilling and freezing. In particular, the technology of irradiation has been recognized as one of the safest and most effective methods for inactivating bacteria in raw poultry either freshly chilled or frozen.

It is also recommended that:

1. Frozen food should be heated thoroughly before consumption.
2. Strict hygienic measures should be taken during processing of both fresh and frozen meat.
3. Regulatory body in food industry should extend their search light on to the local market were fresh meat are process for sanction were necessary.

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